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# DEPARTMENT OF LABOR

## Occupational Safety and Health Administration

■

# TOXIC SUBSTANCES; KETONES

## Proposed Exposure Standards

## DEPARTMENT OF LABOR

### Occupational Safety and Health Administration

### [ 29 CFR Part 1910 ]

[Docket No. SCP-1]

### TOXIC SUBSTANCES; KETONES

### Proposed Standards for 2-Butane, 2-Pentanone, Cyclohexanone, Hexone, Methyl n-Amyl Ketone, Ethyl Butyl Ketone

I. *Introduction.* On March 18, 1974, the Assistant Secretary of Labor for Occupational Safety and Health announced the joint OSHA/NIOSH Standards Completion Project. The purpose of the project is to issue more complete standards for all of the toxic substances listed in Tables G–1, G–2, and G–3 of 29 CFR 1910.93, with the exception of those substances which are or will be the subject of NIOSH Criteria Documents. These exceptions will be covered in separate rulemaking proceedings, outside of the Standards Completion Project.

II. *Background.* Section 1910.93 establishes permissible exposure limits for approximately 400 toxic substances. The permissible limits contained in § 1910.93 refer to airborne concentrations of a given substance. This is not to say, however, that other forms of the substance, e.g., liquid forms, are harmless. The permissible exposure limits (also referred to as eight-hour time weighted averages (TWA) listed in § 1910.93 are not at issue in this proceeding, and no changes to these limits will be proposed or made in the standards issued as part of the Standards Completion Project.

As the first phase of the Standards Completion Project, the Occupational Safety and Health Administration (OSHA) proposes to amend Part 1910 of Title 29 Code of Federal Regulations by the addition of provisions for six ketones: 2-butanone, 2-pentanone, cyclohexanone, hexone, methyl n-amyl ketone and ethyl butyl ketone. The proposed standards, if adopted, will establish requirements for measurement of employee exposure, medical surveillance, methods of compliance, handling and use of liquid forms of the substance, employee training, recordkeeping, and sanitation and housekeeping, among other things.

In addition, the proposals are designed to enable employers to better understand and comply with existing OSHA safety and health standards that relate to the above listed substances. For example, the proposed standards attempt to compile in a single place, by the use of cross references, requirements appearing elsewhere in Part 1910 which are likely to be of particular importance where any of the above listed ketones are present or are used in the workplace. Further, many of the existing OSHA standards that would apply to the use of the ketones involve a classification system. For example, § 1910.309, which references the National Electrical Code, specifies the construction and installation of electrical equipment to be used in areas where various types of hazardous materials are present. These materials are listed in terms of classes, groups and divisions, e.g. Class I, Group D. Although the National Electrical Code lists classifications for a number of hazardous materials, the list does not attempt to encompass the large number of materials encountered in industry. Thus, it is often left to the employer to decide the classifications of substances found in his establishment.

To determine the classes and groups of materials found in a particular workplace, however, the employer must evaluate the explosion characteristics of the materials. Some of the properties that must be determined include: maximum explosion pressure; maximum safe clearance between parts of a clamped joint in an enclosure; and the minimum ignition temperature of the atmospheric mixture. Determination of these properties would be difficult for the average employer. The proposed standards will aid the employer in complying with § 1910.309 by supplying the proper classification of each substance in the text of the standards.

*Toxic materials.* The proposed standards apply to the following toxic substances:

*2-Butanone* (Common synonyms: methyl ethyl ketone, MEK), Chemical Abstracts Service Registry Number 78933, is a colorless, volatile liquid that is flammable. It has a fragrant, mint-like odor. Originally produced as a by-product of wood distillation, it is now commercially produced by the dehydrogenation of sec-butyl alcohol and from butlyene oxide. 2-butanone is used as a solvent, especially in conjunction with other solvents, for cellulose compounds. It is also used in the pharmaceutical and cosmetics industries. Demand for the chemical in 1973 was estimated at 532 million pounds.

2-Butanone is capable of causing narcosis and irritation of the eyes and mucous membranes. It is known to cause dermatitis upon repeated or prolonged contact with the skin.

*2-Pentanone* (Common synonym: methyl n-propyl ketone), Chemical Abstracts Service Registry Number 107879, is a colorless, volatile liquid. It is flammable and has an odor similar to 2-butanone. It is produced by the oxidation of 2-pentanol. 2-Pentanone is used as a solvent, as a substitute for diethyl ketone, and as a flavoring. It is not presently known to be in large-scale commercial production.

Improper exposure may produce narcosis, leading to coma. 2-pentanone is irritating to the eyes and mucous membranes. Prolonged or repeated skin contact can result in dermatitis.

*Cyclohexanone* (Common synonyms: cyclohexyl ketone; ketohexamethylene; pimelic ketone), Chemical Abstracts Service Registry Number 108941, is a colorless-to-pale yellow, volatile liquid that has the familiar mint-like odor peculiar to ketones. It is a combustible liquid, produced by the catalytic oxidation of cyclohexanol or by distillation of pimelic acid salts. The major uses for cyclohexanone are as an intermediate in the manufacture of nylon 6,6 polymer and as a solvent for lacquers and synthetic resins. Demand for the chemical in 1973 was 638 million pounds.

Inhalation of cyclohexanone vapor may result in irritation of the mucous membranes, depression of the central nervous system and narcosis. Cyclohexanone may cause eye irritation. Prolonged or repeated contact with liquid cyclohexanone is capable of defatting the skin, which may result in irritation or dermatitis.

*Hexone* (Common synonyms: methyl isobutyl ketone; 4-methyl-2-pentanone; MIBK), Chemical Abstracts Service Registry Number 108101, is a colorless, flammable liquid. Hexone has a fragrant, mint-like odor peculiar to ketones. It is made commercially by the catalytic hydrogenation of mesityl oxide. Hexone is commonly used as a solvent for lacquers, cellulose esters, vinyl polymers and copolymers, and for many natural and synthetic resins. The demand for the substance in 1973 was 215 million pounds.

Hexone has an irritating odor at low concentrations. The vapor is irritating to the eyes and mucous membranes, and may cause headache and nausea. Repeated or prolonged skin contact with liquid hexone can cause defatting of the skin, which may result in irritation or dermatitis.

*Methyl n-amyl ketone* (Common synonyms: 2-heptanone, MAK), Chemical Abstracts Service Registry Number 110430, is a colorless, volatile, combustible liquid. It has a mild, banana oil-like odor. Methyl n-amyl ketone is produced commercially by the catalytic dehydrogenation of 2-heptanol. The substance is used in perfume making as a constituent of artificial carnation oils, and as an industrial solvent.

Methyl n-amyl ketone is a toxic material that is absorbed into the blood through inhalation and, to a much lesser extent, absorbed through the skin. Symptoms of exposure include eye and mucosal irritation, headache, dizziness and narcosis, eventually leading to unconsciousness. Prolonged or repeated skin contact with liquid methyl n-amyl ketone may result in irritation and dermatitis.

*Ethyl butyl ketone* (Common synonyms: 3-heptanone, EBK), Chemical Abstracts Service Registry Number 106354, is a clear, volatile, combustible liquid with a mild, fruity odor. Ethyl butyl ketone is produced commercially by dehydrogenation of the mixed alcohol condensation product of propionaldehyde and methyl ethyl ketone, or by catalytic dehydrogenation of 3-heptanol. It is used primarily as a solvent for organic materials, and as an intermediate in the making of other organic products. Demand for the substance in 1973 was less than 200,000 pounds.

Ethyl butyl ketone is irritating to the eyes and mucous membranes. Inhalation of ethyl butyl ketone vapor may also cause headache, drowsiness and nausea.

Acute overexposure may cause pharyngitis and bronchitis. Repeated or prolonged skin contact with liquid ethyl butyl ketone may result in irritation and dermatitis.

*The proposal.* OSHA proposes to amend Part 1910 by the addition of standards for 2-butanone, 2-pentanone, cyclohexanone, hexone, methyl n-amyl ketone, and ethyl butyl ketone. The proposal includes the following major points.

*Definitions.* The proposal defines permissible exposure by reference to the TWA's currently found in Table G–1 of § 1910.93. As previously stated, these exposure limits are not at issue in this proceeding, and no changes have been made in the TWA's stated in Table G–1.

The proposed standards define action level as one half of the permissible exposure limit. The action level is the point at which certain provisions of the proposed standards must be initiated, such as employee exposure measurement, training of employees and medical surveillance.

Section 6(b)(7) of the Act directs that, where appropriate, occupational health standards shall prescribe employee exposure measurements and medical examinations. OSHA recognized the need to designate a level of exposure at which these procedures become appropriate. The function of the action level is to designate this level of exposure.

OSHA decided that the action level, which triggers the measurement requirements, be set well below the permissible exposure level to better protect employees from overexposure. It was determined that this method was the most reasonable approach to a recurring problem, that is, how to provide the maximum employee protection necessary with the minimum burden to the employer. Thus where the results of employee exposure measurements demonstrate that no employee is exposed to airborne concentrations of a substance in excess of the action level, employers are, in effect, exempted from major provisions of the standard. In particular, for those employees not exposed to concentrations exceeding the action level, it would not be necessary to provide special training, obtain medical history statements, or monitor such employees unless there is a change in production, process, or control measures which could result in an increase in airborne concentrations of the substance.

A duty to measure employee exposure and provide medical surveillance only when the employee exposure was equal to or over the permissible level was rejected as not providing sufficient protection for the exposed employees. Among other things, such a scheme would not protect the employee from overexposure because the employer would have no way of knowing when airborne concentrations of a regulated substance approach the TWA. It would not be possible to ensure that exposures are kept within the permissible limits if sampling is done only when an employee's exposure is at the permissible level.

Also, no measuring system is completely accurate. The proposal requires that the method of measurement used should have an accuracy of plus or minus 35 percent when concentrations are between the action level and the permissible exposure level. While there are some measuring methods with greater accuracy than the minimum prescribed in the proposal, it was decided to allow a measurement method of this accuracy at these concentrations because, among other reasons, this would allow the employer to use simple inexpensive gas detector tubes to fulfill the measurement requirements. In view of the limitations on the accuracy of the measurement program, measuring must be started well below the permissible exposure level to assure a sufficiently reliable indication that exposures are within permissible limits.

It was determined that three key duties should be triggered by the action level: exposure measurement, medical surveillance and employee training. All three actions were considered necessary before employee exposure reached the permissible level or higher. As noted above, it is important to begin measurement procedures when approaching the permissible exposure level to ensure that employee exposure does not exceed the permissible exposure. Similarly, employees should be screened for pre-existing medical conditions and trained so that they learn suitable precautions against dangerous properties of the substance when there is some chance that their exposure is significant.

An alternative to having an action level would be to require the medical and measurement procedures at any level of exposure, no matter how minor. This alternative, however, would unnecessarily burden employers because they would be required to implement the medical and measurement provisions even where concentrations were so low that they presented no health problem.

*Exposure measurement.* In establishments where any of the regulated ketones are released into the workplace air, the employer is required to make a written initial determination, which is an estimate of whether any employee may be exposed to concentrations in excess of the action level. This written determination must be made even if the results are negative; that is, even if the employer determines that no employee is exposed above the action level. The initial determination is normally a simple calculation of exposure based on the amount of the regulated substance present in the workplace, the size of the workplace, the type of operation being performed, the amount and type of ventilation, and the proximity of employees to the substance emission source. The proposal does not require the employer to measure or sample airborne concentrations when performing this initial determination, but if any measurements are taken, they must be considered. However, the employer must be certain that the initial determination accurately reflects employee exposure conditions over the working day.

The determination must also include any information or any observations that indicate an employee may be exposed in excess of the action level. Such information may include: employee complaints of signs or symptoms that may be attributed to overexposure; reports from OSHA or NIOSH on the results of surveys or inspections; results of a survey performed by a professional industrial hygienist; and relevant information from insurance companies and trade associations.

In establishments having more than one work situation involving a regulated substance, an initial determination must be made for each situation. For example, in a plant where a regulated substance is used in dip tank and spray finishing operations, an initial determination must be made for both operations. This determination must be repeated each time there is a change in production, process or control measures which could result in an increase in airborne concentrations of the regulated substance.

When the initial exposure determination indicates that any employee may be exposed in excess of the action level, the employer must measure the exposure of the employee most likely to have the highest exposure. If the results of this measurement indicate that the employee is exposed to concentrations in excess of the action level, the employer must implement a program to measure the exposures of all employees similarly affected.

If such measurements show that an employee is exposed to concentrations above the action level, but below the permissible exposure level, measurements of that employee's exposure must be made every two months. If the measurements show that an employee is exposed to concentrations above the permissible limit, the employer must measure the employee's exposure at least monthly, inform the employee of his overexposure, and institute control measures to reduce exposure to within permissible limits. If the results of two consecutive measurements, taken at least one week apart, show that an employee is not exposed above the action level, the measurement program may be terminated for that employee.

The measurement provisions are designed in this step-by-step fashion so that employers having workplaces where only low concentrations of ketones are present will not be required to measure the exposure of each individual employee. The intent of this procedure is to provide adequate protection for employees while minimizing the administrative and financial burden on employers.

The frequency of measurement would depend on the degree of employee exposure. Bi-monthly measurement for employees whose exposures are in the range between the action level and permissible level is intended to assure that the permissible exposure is not exceeded and to provide sufficient warning when

exposures are approaching the permissible limit. A minimum bi-monthly sampling frequency would be required because the data from fewer samples would not provide statistical information of an accuracy necessary to assure protection of employees.

Where employee exposures are above the permissible limit, monthly measurements would be required because OSHA believes that exposure above the permissible level presents a hazard to the employee. Monthly measurements would also be required even when employees routinely wear respirators, because the type of respirator to be worn is determined by the concentrations of the regulated substance present in the workplace air.

The proposal provides for the termination of exposure measurement when two samples indicate levels below the action level. Two samples, rather than one, are required in order to allow for the normal variability of individual exposure measurements, which may produce unrepresentative results. A requirement for a period of one week between samples has been included to ensure that any recorded decrease in exposure levels is not merely a short-term reduction in exposure resulting from temporary process or weather changes. It should be noted that the termination of measurement requirements would be effective only as long as there is no change in production, process or control which could result in new or increased exposure. If such a change occurs, the procedure, beginning with the initial determination, must be repeated.

*Methods of measurement.* The provisions of the proposed standards regarding methods of measurement are designed to assure that employee exposures are measured according to methods that will produce relatively accurate results.

There are no specifications in the proposed standards concerning the duration or number of samples which must be taken to determine individual employee exposures. Any appropriate combination of long-term or short-term samples would be acceptable, although the proposal would require that all exposures be calculated on an eight-hour time-weighted average basis. Moreover, the employer is not required to use a specific measurement method, but rather can use any method meeting specified precision and accuracy requirements. This leaves the employer with a wide range of choices in selecting the method which best fits the particular situation.

The required accuracy values do allow the use of relatively inexpensive measurement methods, such as NIOSH-certified gas detector tubes. Appendix B, the Substance Technical Guidelines, recommends that the eight hour exposure be determined from a single sample or from two four hour samples. Appendix B is intended to be an information source for the employer and is provided to aid the employer in meeting the requirements of the standard.

The accuracy of the sampling method must have a confidence level of 95 percent. "Accuracy" refers to the difference between a measured value and the true concentration. It allows for both the random variation of the measurement method (its precision), and the difference between the average result from the method and the true value (bias of the method). For example, the required accuracy for concentrations of the regulated ketones above the permissible exposure limit is 25 percent at a 95 percent confidence level. This means that out of a long series of measurements, 95 percent must be within 25 percent of the true value.

*Methods of compliance.* The proposed standard requires that engineering or work practice controls shall be used to reduce exposure to the regulated substances to at or below the permissible exposure limit. However, in situations where engineering and work practice controls are not sufficient to reduce exposures to the permissible limit, they shall nonetheless be used to reduce exposures to the lowest level feasible, and shall be supplemented by the use of respirators.

Engineering controls are the preferred means of compliance because they reduce airborne concentrations of a substance at the source of emission, and they are not highly subject to human error. Work practice controls, such as good housekeeping, which reduce spills and other sources of emissions, and actions taken by employees to stay out of high concentration areas when the work does not require them to be there, are only as good as the supervision provided. Also, failures of work practice controls are not generally as easily detected and controlled as are failures of engineering controls. While work practice controls may not be as reliable as engineering controls in reducing employee exposures, they share a preferred position with engineering as acceptable methods of compliance.

When mechanical ventilation is used as an engineering control, the system must be tested at least every three months to ensure proper functioning. This test frequency will detect minor changes which may reduce the expected efficiency of the ventilation system. Massive failures provide adequate warning.

Changes in production, process, or control, however, require retesting of the ventilation system to assure that no reduction in control has inadvertently occurred. A mechanical ventilation system is a safety device, and like all safety devices, should be tested periodically.

*Respiratory protection.* Respirators are the least satisfactory means of exposure control because they are capable of providing good protection only if they are properly selected, properly fitted, and if they are worn by the employee, and if they are replaced when they cease to provide adequate protection. While it is possible for all of these conditions to be met, it is more often the case that they are not, and as a consequence the protection of employees by respirators is not effective. Further, employees with impaired respiratory function may not be able to wear certain types of respirators, such as those operating in the negative pressure mode.

Despite the inherent difficulties associated with respirator use, they remain the only form of protection when engineering and work practice controls are not feasible or are inadequate. The proposed standard allows respirators to be used to control employee exposure in certain other specific situations, including operations requiring respirator use for not more than one hour per day, one day per week, and in emergencies. The proposal requires the employer to select NIOSH–MESA approved respirators. Acceptable respirators prescribed in this proposal were selected after consideration of the concentration of toxic substance present, warning properties of the substance, whether the vapor causes eye irritation, the level of the substance that would be immediately dangerous to life or health, protection factors and other related information. Table 2 lists the respirators acceptable under various conditions. However, the employer may always select a respirator providing greater protection; that is, one prescribed in Table 2 for higher concentrations of a substance than are present in the workplace.

*Fire and safety.* The proposed standards would require the employer to familiarize himself with the guidelines for the safe handling and use of the regulated materials. These guidelines are found in Appendix B. The guidelines deal with fire and explosion hazards inherent in the ketones and together with other provisions of this paragraph, provide a basic reference of the known safety and health hazards of the regulated substances.

*Personal protection equipment.* The ketones are defatting agents, capable of causing or aggravating skin irritations which may create susceptibility to infections. The proposal provides for use of impervious clothing, gloves, face shields and other appropriate protective clothing needed to prevent employees from being subjected to repeated or prolonged skin contact with liquid ketones. Such protection is not mandatory in situations which present no danger of repeated skin contact, since occasional contact with the regulated substances does not present a health hazard.

However, if clothing becomes wet with one of the substances, the proposed standard requires the employer to ensure that such clothing be removed and not reworn until the substance is removed from the clothing. In the case of volatile substances such as the ketones, removal from the clothing may be achieved by simply allowing the clothing to dry. The requirement for prompt removal of clothing that has become wet with one of the regulated substances is based on two types of hazards. First, skin contact with the wet clothing could result in irritation or dermatitis. Second, such clothing can easily catch fire.

*Spills.* The proposed standard requires that ketone spills be cleaned up immediately after eliminating potential

sources of ignition and providing all available ventilation. In addition, to decrease the risk of fire or explosion, this paragraph prohibits allowing liquid ketones to enter confined spaces, such as sewers or drainage systems.

*Training and information.* Whenever the ketones are present, the employer is required to have copies of these regulations present in the workplace and make them available to employees. This merely assures that those who wish to do so can readily obtain information concerning possible hazards in their work environment.

The proposal would require the employer to provide an annual training program for: employees exposed to airborne concentrations of the regulated ketones in excess of the action level; employees having skin contact with liquid ketones; or employees working where the regulated substances present a fire or explosion hazard. This employee training program must at a minimum present the information contained in the Substance Safety Data Sheet (Appendix A), review the signs and symptoms of exposure, and the medical conditions which may be aggravated by exposure to the regulated materials, and instruct the employees to report any such signs, symptoms or medical conditions to the employer. Also, employees must be trained in the safe use of the substances, emergency procedures, and correct use of protective equipment. This training will contribute to employee protection by providing information which will enable employees to protect themselves from hazards which may be encountered in working with these toxic substances.

*Medical surveillance.* The proposal requires the employer to obtain a limited medical history from all employees who are, or who will be, subject to skin contact with liquid forms of the substances or will be exposed to airborne concentrations at or above the action level. The purpose of a medical history is to reveal known, pre-existing medical conditions which could be affected by exposure to the ketones. Preplacement medical examinations are required only if an employee indicates a history of certain conditions which may place him at increased risk. Medical examinations must also be made available to any employee who reports that he has developed any of the specified medical conditions, or that he has developed any of the signs or symptoms of over exposure to the ketones listed in the Substance Safety Data Sheet in Appendix A.

When a medical examination is required, the employer must provide the examining physician with a copy of these standards; a description of the employee's duties as they relate to his exposure so that the physician will understand the circumstances which lead to exposure to the substance; a description of any personal protective equipment to be used by the employee, including respirators; and information concerning actual and estimated exposures to which the employee has been or may be exposed. If requested by the physician, the employer must also provide any available employee medical history information. This provision will assure that the physician has enough information readily available so that he may provide an opinion based on all the relevant facts. Appendix C is provided to aid the physician in evaluating any health hazard to the employee.

Following the medical examination, the employer must obtain a written opinion from the examining physician stating whether the employee has any medical condition that would place him at increased risk to his health, or that would be aggravated by exposure to one of the regulated ketones. The written opinion must also state any recommended limitations on the employee's exposure to the ketones and any limitations upon the employee's ability to wear respirators or other protective equipment. Further, the opinion must state that the employee has been informed of any medical conditions which would require further examination or treatment. However, the written opinion shall not contain specific findings or diagnoses unrelated to the employee's exposure to any of the regulated substances encountered in the workplace. The proposal also provides that no employee shall be exposed to a regulated substance in such a way as would put the employee at increased risk of material impairment of his health from such exposure.

*Recordkeeping.* The proposal requires the employer to maintain written records of the following: written initial exposure determinations, measurements of employee exposures, tests of mechanical ventilation systems (where such systems constitute engineering controls), annual training sessions, and records required by employee medical surveillance provisions.

*Access to Records.* The proposals provide for access to records of exposure measurements by employees, former employees or their representatives, and access to medical records by physicians designated by employees or former employees. In the case of former employee medical records, however, it should be noted that the employer is only required to retain such records for the duration of the employment of the affected employee.

*Observation of measurement.* Section 8(c)(3) of the Act provides that where measuring of employee exposure to a toxic substance is required by a standard, the Secretary shall by regulation ensure that employees or their representatives have an opportunity to observe such measurement.

Accordingly, the proposed standard would require employers to give affected employees or their representatives an opportunity to observe any measuring of employee exposure to any of the regulated substances conducted pursuant to these regulations. The proposal requires the observers to use whatever personal protective devices are required, and to comply with all other applicable safety procedures.

In order to effectively exercise the opportunity, observers would be entitled to receive an explanation of the measurement procedure, observe all the steps related to the measurement procedure that are performed at the place of exposure, and to record the results obtained.

As stated in 29 CFR 1910.5 specific rules prevail over more general ones. It should be noted that this proposal, if adopted, will supersede §§ 1910.134 (c) and (g), 1910.93(e), 1910.133(a)(1) as they relate to these ketones and any other provision of Part 1910 which is not consistent with the provisions contained herein. A notice of intent to prepare an environmental impact statement was published in the FEDERAL REGISTER on September 20, 1974 (39 FR 33843).

*Public participation.* Interested persons are invited to comment on the proposed standard. Written data, views and arguments concerning the proposal must be submitted in quadruplicate to Nancy Hucke, Docket Officer, Docket SCP–1, Occupational Safety and Health Administration, Room 200, 1726 M Street, NW., Washington, D.C. 20210, on or before June 20, 1975. Written submissions must clearly identify the provision of the proposal addressed and the position taken with respect to each such provision. The data, views and arguments will be available for public inspection and copying at the above address. All written submissions received will be made a part of the record of this proceeding.

In order to expedite this rulemaking proceeding and in anticipation of requests for a hearing, we are scheduling an informal public hearing, pursuant to section 6(b) of the Act and 29 CFR Part 1911, to begin on August 5, 1975 in the Departmental Auditorium, Conference Room B, U.S. Department of Labor, Constitution Avenue between 12th and 14th Streets, NW., Washington, D.C. All aspects of the proposed standard, including its environmental impact will be at issue in the hearing.

Persons desiring to appear at the hearing must file a notice of intention to appear on or before June 20, 1975, with Nancy Hucke, OSHA Committee Management Office, Docket SCP–1, 1726 M Street, NW., Room 200, U.S. Department of Labor, Washington, D.C. 20210 (Telephone: 202/961–2248 or 2487). The notice must contain the following information:

(1) The name and address of the person to appear;

(2) The capacity in which he will appear;

(3) The approximate amount of time required for the presentation;

(4) The specific provisions of the proposal that will be addressed;

(5) A brief statement of the position that will be taken with respect to each provision addressed; and

(6) A summary of the evidence with respect to each such provision proposed to be adduced at the hearing.

OSHA has determined that strict enforcement of its procedural rules contained in 29 CFR 1911.11 is necessary for

an expeditious and orderly proceeding. Therefore the notices of intent to appear will be scrutinized closely for sufficiently detailed information concerning the position to be taken with regard to the issues specified and the evidence to be adduced in support of the position. Persons filing notices of intent to appear which are not sufficiently detailed will be so informed and given fifteen days from the date they are so informed to file a proper notice of intent to appear. In addition, the amount of time requested for each presentation will be reviewed in light of the contents of the notice of intention to appear. In those cases where the information contained in the notice of intention to appear does not seem to warrant the amount of time requested, the participant will be allocated a more appropriate amount of time and notified of this fact. The participant will have fifteen days from the date on which he was so informed to demonstrate why the allocated time is inappropriate.

The hearing will commence at 9:30 a.m. with the establishment of the order and time for presentation of statements and the resolution of any other procedural matters relating to the proceeding. The hearing will be conducted, and the decisions made, in accordance with 29 CFR Part 1911.

The oral proceedings will be reported verbatim. All statements and documents that are intended to be submitted for the record of the hearing must be submitted in quadruplicate.

The use of prepared statements by witnesses is encouraged.

The Administrative Law Judge shall have all the powers necessary or appropriate to conduct a fair and full informal hearing, including the powers:

(a) To regulate the course of the proceedings;

(b) To dispose of procedural requests, objections, and comparable matters;

(c) To confine the presentations to matters pertinent to the proposed standard;

(d) To regulate the conduct of those present at the hearing by appropriate means;

(e) In his discretion, to question and permit questioning of any witnesses; and

(f) In his discretion, to keep the record open for a reasonable, stated time to receive written information from any person who has participated in the oral proceeding.

Following the close of the hearing, the presiding Administrative Law Judge shall certify the record thereof to the Assistant Secretary of Labor for Occupational Safety and Health.

All relevant oral and written information, data, views, or arguments will be considered subsequent to the certification of the record and the proposal will be modified appropriately if the submissions so warrant.

Accordingly, pursuant to sections 6(b) and 8(c)(3) of the Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1599; 29 U.S.C. 655, 657), Secretary of Labor's Order No. 12–71 (36 FR 8754), and 29 CFR Part 1911, it is hereby proposed to amend Part 1910 of Title 29, Code of Federal Regulations by adding six new sections as set forth below.

Sec.
1910.93s 2-Butanone.
1910.93t 2-Pentanone.
1910.93u Cyclohexanone.
1910.93v Hexone.
1910.93w Methyl (n-amyl) ketone.
1910.93x Ethyl Butyl ketone.

### § 1910.935 2-Butanone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of 2-butanone, not in excess of 200 parts per million (ppm) or 590 milligrams per cubic meter (mg/cu m) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.93, Table G–1.

(2) "Action level" means one half (½) of the permissible exposure for 2-butanone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which 2-butanone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of 2-butanone at or above the action level. The determination shall be made each time there is a change in production, process or control measures which could result in an increase in airborne concentrations of 2-butanone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observation, or calculations which may indicate employee exposure to 2-butanone;

(ii) Any measurements of 2-butanone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to 2-butanone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to 2-butanone at or above hte action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to 2-butanone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to 2-butanone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals an employee is exposed to 2-butanone above the permissible exposure, the employer shall:

(i) Measure the exposure of the employee so exposed monthly;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to 2-butanone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to 2-butanone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B(IV) of this section for suggested measurement methods).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration: | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to 2-butanone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of 2-butanone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever feasible engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an

increase in airborne concentrations of 2-butanone.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94(d), operations involving 2-butanone shall be classified as B–1 at 70 degrees F.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of 2-butanone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE B.—RESPIRATORY PROTECTION FOR 2-BUTANONE

| Condition vapor concentration: | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge. |
| 3,000 p/m or less | A gas mask with a chin-style organic vapor canister.<br>A gas mask with a front- or back-mounted organic vapor canister.<br>Any supplied-air respirator with a full facepiece, helmet, or hood.<br>Any self-contained breathing apparatus with a full facepiece. |
| Greater than 3,000 p/m or entry and escape from unknown concentrations | Self - contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode.<br>A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in the pressure-demand (positive pressure) or continuous flow mode and an auxiliary self - contained breathing apparatus operated in the pressure-demand (positive pressure) mode. |
| Condition vapor concentration: | *Respiratory protection* |
| Firefighting | Self - contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e) and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for 2-butanone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of 2-butanone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, 2-butanone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of 2-butanone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid 2-butanone is classified as a Class 1B flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where 2-butanone is present in the ductwork in concentrations greater than 4500 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(9) Sources of ignition such as smoking or open flames are prohibited where 2-butanone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 2-butanone. Face shields shall comply with § 1910.133(a)(2), (4), (5), and (6).

(2) Employers shall ensure that clothing which becomes wet with 2-butanone be removed immediately and not reworn until the 2-butanone is removed from the clothing.

(3) Employers shall ensure that clothing wet with 2-butanone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of 2-butanone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2-butanone, the employer shall inform the person performing the operation of the hazardous properties of 2-butanone.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133 (a)(2)–(a)(6) where liquid 2-butanone may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid 2-butanone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid 2-butanone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes wet with liquid 2-butanone promptly wash or shower as necessary to remove any 2-butanone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which 2-butanone is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to 2-butanone above the action level or employees who have skin contact with liquid 2-butanone or employees who work where 2-butanone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for 2-Butanone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to 2-butanone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to 2-butanone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to 2-butanone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid 2-butanone or airborne concentrations of 2-butanone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to 2-butanone which are listed in Appendix A which the employee suspects are caused by exposure to 2-butanone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes, A, B and C for 2-butanone;

(ii) A description of the affected employee's duties as they relate to his exposure to 2-butanone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physican specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to 2-butanone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to 2-butanone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnosis unrelated to exposure to 2-butanone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid 2-butanone or airborne concentrations of 2-butanone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to 2-butanone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to 2-butanone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to 2-butanone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to 2-butanone;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to 2-butanone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to 2-butanone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne 2-butanone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes to § 1910.935 is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR 2-BUTANONE

I. SUBSTANCE IDENTIFICATION

A. SUBSTANCE: 2-butanone

B. PERMISSIBLE EXPOSURE: 200 parts of 2-butanone per million parts of air (ppm) or 590 milligrams of 2-butanone per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. APPEARANCE AND ODOR: Colorless liquid with a fragrant, mintlike, moderately sharp odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: 2-Butanone can affect your body if you inhale it, swallow it, or if it comes in contact with your skin or eyes.

B. Effects of Exposure: 1. Short-Term Exposure: 2-Butanone may cause irritation of the eyes, nose, and throat, headache, dizziness, upset stomach, vomiting and unconsciousness.

2. Long-Term Exposure: Prolonged or repeated exposure to liquid 2-butanone may cause drying and irritation of the skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any of the above signs or symptoms and suspect they are associated with 2-butanone exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If 2-butanone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If 2-butanone gets on your skin, promptly wash the skin using soap or mild detergent. If 2-butanone soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists get medical attention.

C. Breathing: If you or any other person breathes in large amounts of 2-butanone, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When 2-butanone has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. RESPIRATORS: Respirators are not the best way to control exposure to 2-butanone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell 2-butanone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield, or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid 2-butanone.

C. EYE PROTECTION: You must wear splash-proof safety goggles where eye contact with liquid 2-butanone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

2-Butanone is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever 2-butanone is handled, used, or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of 2-butanone and containers must be bonded and grounded when pouring or transferring liquid 2-butanone. You must promptly wash or shower using soap or mild detergent to remove any 2-butanone from your skin. You must immediately remove any clothing that becomes wet with liquid 2-butanone and this clothing must not be reworn until the 2-butanone has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where 2-butanone is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS.

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR 2-BUTANONE (MEK)

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Methyl Ethyl Ketone (MEK), Ethyl Methyl Ketone

2. Formula: $CH_3COCH_2CH_3$

B. Physical Data

1. Boiling Point (760 mm hg): 79.6 C (175 F)

2. Specific Gravity (water = 1): 0.806

3. Vapor Density (air = 1): 2.5

4. Melting Point: −86.3 C (−122.8 F)

5. Vapor Pressure @ 20 C (68 F): 70 mm Hg

6. Solubility in Water, % by weight @ 20 C (68 F): 27.1

7. Evaporation Rate (Butyl Acetate = 1): 5.7

8. Appearance and Odor: clear and colorless liquid with fragrant, mintlike, moderately sharp odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

*A. Fire.* 1. Flash Point: −6.1 C (21 F) (closed cup)

2. Autoignition Temperature: 515.5 C (959 F)

3. Flammable Limits in Air, % by volume: Lower 1.8%; Upper: 10 %.

4. Extinguishing media: carbon dioxide, dry chemical, or alcohol foam

5. Special Fire-fighting Procedures: Do not use solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual Fire and Explosion Hazards: 2-Butanone is a flammable liquid. Its vapors can easily form explosive mixtures in air All ignition sources must be controlled when 2-butanone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. 2-Butanone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the 2-butanone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, 2-butanone is classified as a class IB flammable liquid. For example 4500 ppm, one fourth of the lower flammable limit, is one situation in which 2-butanone is considered to be a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for 2-butanone shall be Class I, Group D.

B. *Reactivity.* 1. Conditions contributing to instability: Heat.

2. Incompatibility: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 2-butanone.

4. Special Precautions: 2-Butanone will attack and dissolve many forms of plastics, resins, and rubber.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If 2-butanone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber, or absorbed on vermiculite, dry sand, earth, or similar material and disposed of in a sanitary landfill. 2-Butanone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

2-Butanone may be disposed of:

1. By atomizing in a suitable combustion chamber.

2. By absorbing it in vermiculite, dry sand, earth, or similar material and disposing in a sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by calibrated instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses, or dosimeters. The method of measurement must determine the concentration of 2-butanone to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph (IV)(A). The method of measurement must determine the concentration of 2-butanone to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to 2-butanone can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal 2-butanone containers which must then be effectively grounded and bonded prior to pouring.

C. Store 2-butanone in tightly closed containers in a cool, well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations in which exposures to 2-butanone could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to 2-butanone is likely to occur are during its use as a solvent for plastics, gums, resins, lacquers, varnishes, and waxes. It is also used in the manufacture of pharmaceuticals, cosmetics, and synthetic rubber.

APPENDIX C

MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; insignificant skin absorption

II. TOXICOLOGY

There is some local irritation of tissues by the solvent effect of 2-butanone on lipids, and central nervous system depression may occur on exposure to high concentrations producing narcosis. Effects may be more pronounced in unacclimated individuals. No chronic systemic effects reported.

III. SIGNS AND SYMPTOMS

Irritation of eyes and mucous membranes of upper respiratory tract; headache. Exessive skin contact may produce a dermatitis. Narcosis leading to coma may occur at sustained high levels.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. *General.* Most reported effects of 2-butanone are caused by its irritant properties. It is important that the physician become familiar with the operating conditions in which exposure to 2-butanone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. *Preplacement.* Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease—Although 2-butanone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease—In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 2-butanone might cause exacerbation of symptoms due to irritant properties or psychic reflex bronchospasm.

3. Liver disease—Although 2-butanone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Skin disease—2-butanone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of 2-butanone.

C. *Periodic examinations.* Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

REFERENCES

1. Grant, W. Morton: Toxicology of the Eye, (Second Edition), Charles C. Thomas, Illinois, 1974, page 663.

2. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevzer Publishing Company, Amsterdam, 1965, pp. 440–442.

3. Patty, F. A.: Industrial Hygiene and Toxicology, Volume II—Toxicology, Interscience Publishers, New York, 1953, pp. 1756–1758.

## § 1910.93t 2-Pentanone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of 2-pentanone, not in excess of 200 parts per million (ppm) or 700 milligrams per cubic meter (mg/cu m) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.93, Table G–1.

(2) "Action level" means one half (½) of the permissible exposure for 2-pentanone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which 2-pentanone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of 2-pentanone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of 2-pentanone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observation, or calculations which may indicate employee exposure to 2-pentanone;

(ii) Any measurements of 2-pentanone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to 2-pentanone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to 2-pentanone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to 2-pentanone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to 2-pentanone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals an employee is exposed to 2-pentanone above the permissible exposure, the employer shall:

(i) Measure the exposure of the employee so exposed monthly;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to 2-pentanone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to 2-pentanone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this pargaraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B(IV) of this section for suggested measurement methods).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration: | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to 2-pentanone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of 2-pentanone shall be controlled to at or below the permissible exposure by engineering and work practice controls.

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever feasible engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of 2-pentanone.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94 (d), operations involving 2-pentanone shall be classified as B–1 at 70 degrees F.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls: or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of 2-pentanone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for 2-Pentanone*

| Condition vapor concentration: | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with an organic vapor cartridge.<br>Any self-contained breathing apparatus.<br>Any supplied-air respirator. |
| 5,000 p/m or less | A gas mask with a chin-style organic vapor canister.<br>A gas mask with a front- or back-mounted organic vapor canister.<br>Any supplied-air respirator with a full facepiece, helmet, or hood.<br>Any self-contained breathing apparatus with a full facepiece. |
| Greater than 5,000 p/m or entry and escape from unknown concentrations. | Self - contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode.<br>A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in the pressure-demand (positive pressure) or continuous flow mode and an auxiliary self - contained breathing apparatus operated in the pressure-demand (positive pressure) mode. |
| Firefighting | Self - contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e) and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for 2–pentanone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of 2-pentanone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, 2-pentanone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of 2-pentanone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid 2-pentanone is classified as a Class IB flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where 2-pentanone is present in the ductwork in concentrations greater than 3750 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(9) Sources of ignition such as smoking or open flames are prohibited where 2-pentanone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 2-pentanone. Face shields shall comply with § 1910.133(a) (2), (4), (5), and (6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with 2-pentanone be removed promptly and not reworn until the 2-pentanone is removed from the clothing.

(3) Employers shall ensure that clothing wet with 2-pentanone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of 2-pentanone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2-pentanone, the employer shall inform the person performing the operation of the hazardous properties of 2-pentanone.

(4) Employers shall ensure that clothing which becomes wet with liquid 2-pentanone be removed immediately and not reworn until the 2-pentanone is removed from the clothing.

(5) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where liquid 2-pentanone may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid 2-pentanone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid 2-pentanone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with 2-pentanone promptly wash or shower to remove any 2-pentanone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which 2-pentanone is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to 2-pentanone above the action level or employees who have skin contact with liquid 2-pentanone or employees who work where 2-pentanone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for 2-Pentanone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to 2-pentanone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to 2-pentanone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j) (2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to 2-pentanone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid 2-pentanone or airborne concentrations of 2-pentanone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to 2-pentanone which are listed in Appendix A which the employee suspects are caused by exposure to 2-pentanone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for 2-pentanone;

(ii) A description of the affected employee's duties as they relate to his exposure to 2-pentanone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurement which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to 2-pentanone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to 2-pentanone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to 2-pentanone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid 2-pentanone or airborne concentrations of 2-pentanone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to 2-pentanone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to 2-pentanone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to 2-pentanone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to 2-pentanone;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to 2-pentanone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to 2-pentanone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne 2-pentanone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes to § 1910.93t is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR 2-PENTANONE

I. SUBSTANCE IDENTIFICATION

A. SUBSTANCE: 2-pentanone.

B. PERMISSIBLE EXPOSURE: 200 parts of 2-pentanone per million parts of air (ppm) or 700 milligrams of 2-pentanone per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. APPEARANCE AND ODOR: Colorless liquid with a characteristic ketone odor.

II. HEALTH HAZARD DATA

A Ways in Whtich the Chemical Affects Your Body: 2-Pentanone can affect your body if you inhale it, swallow it, or it comes in contact with your skin or e yes.

B. Effects of Exposure: 1. Short-Term Exposure: 2-pentanone may cause irritation of the eyes and nose. The exposed person may become drowsy and lose consciousness.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid 2-pentanone may cause a rash.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are associated with 2-pentanone exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If 2-pentanone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If 2-pentanone gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If 2-pentanone soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists get medical attention.

C. Breathing: If you or any other person breathes in large amounts of 2-pentanone, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When 2-pentanone has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. RESPIRATORS: Respirators are not the best way to control exposure to 2-pentanone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell 2-pentanone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield, or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid 2-pentanone.

C. EYE PROTECTION: You must wear splash-proof safety goggles where eye contact with liquid 2-pentanone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

2-Pentanone is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever 2-pentanone is handled, used, or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of 2-pentanone and containers must be bonded and grounded when pouring or transferring liquid 2-pentanone. If your skin becomes contaminated with 2-pentanone, you must promptly wash or shower using soap or mild detergent to remove any 2-pentanone from your skin. You must immediately remove any clothing that becomes wet with liquid 2-pentanone and this clothing must not be reworn until the 2-pentanone has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where 2-pentanone is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS.

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR 2-PENTANONE

PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Methyl propyl ketone; ethyl acetone; MPK

2. Formula: $CH_3COC_3H_7$

B. Physical Data

1. Boiling Point (760 mm HG): 102.3 C (216 F)

2. Specific gravity (water=1): 0.8

3. Vapor density (air=1): 3.0

4. Melting point: −77.5 C (−108 F)

5. Vapor pressure at 20 C (68 F): 27 mm HG

6. Solubility in water, percent by weight at 20 C (68 F): 4.3

7. Evaporation rate (butyl acetate=1): 1.60

8. Appearance and odor: Colorless liquid with a characteristic ketone odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. *Fire.* 1. Flash point: 7.2 C (45 F) (closed cup)

2. Autoignition temperature: 505 C (941 F)

3. Flammable limits in air, percent by volume: Lower: 1.5; Upper: 8.2

4. Extinguishing media: Carbon dioxide, dry chemical or alcohol foam.

5. Special fire fighting procedures: Do not use solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: 2-pentanone is a flammable liquid. Its vapors can easily form explosive mixtures in air. All ignition sources must be controlled when 2-pentanone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. 2-pentanone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the 2-pentanone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, 2-pentanone is classified as a Class IB flammable liquid. For example, 3750 ppm, one fourth of the lower flammable limit, is one situation in which 2-pentanone is considered a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for 2-pentanone shall be Class I, Group D.

B. *Reactivity.* 1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 2-pentanone.

4. Special Precautions: 2-pentanone attacks many plastics and rubbers.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If 2-pentanone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber, or absorbed on vermiculite, dry sand, earth, or similar material and disposed in a sanitary landfill. 2-Pentanone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

2-Pentanone may be disposed of:

1. By atomizing in a suitable, combustion chamber.

2. By absorbing it in vermiculite, dry sand, earth or similar material and disposing in a sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single eight-hour sample or two 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by calibrated instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses, or dosimeter. The method of measurement must determine the concentration of 2-pentanone to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph (IV)(A). The

method of measurement must determine the concentration of 2-pentanone to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS.

A. High exposures to 2-pentanone can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal 2-pentanone containers which must then be effectively grounded and bonded prior to pouring.

C. Store 2-pentanone in tightly closed containers in a cool, well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to 2-pentanone could occur.

VI. COMMON OPERATIONS.

Some common operations in which exposure to 2-pentanone is likely to occur are during its use as a solvent for inks, varnishes, lacquers and coatings.

APPENDIX C

MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; insignificant skin absorption.

II. TOXICOLOGY.

The main toxic effect of overexposure to 2-pentanone is irritation of the eyes, skin, and upper respiratory tract. Removal of lipids and irritation of the skin occurs when there is prolonged contact or repeated exposure to the liquid. Systemic absorption of high doses causes central nervous system depression. No chronic systemic effects are reported.

III. SIGNS AND SYMPTOMS.

Irritation of eyes and mucous membranes of upper respiratory tract; headache; excessive skin contact may produce adermatitis. At sustained high levels, narcosis leading to coma may occur.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS.

A. *General.* Most reported effects of 2-pentanone are caused by its irritant properties. It is important that the physician become familiar with the operating conditions in which exposure to 2-pentanone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. *Preplacement.* Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from 2-pentanone exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Kidney disease—Although 2-pentanone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease—In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 2-pentanone might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

3. Liver disease—Although 2-pentanone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver functions.

4. Skin disease—2-Pentanone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of 2-pentanone.

C. *Periodic Examinations.* Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above-listed conditions, he must refer such employees for further medical examination.

REFERENCES

1. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 425–427.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II. Toxicology (2d ed. revised), Interscience Publishers, New York, 1963, pp. 1734–1735.

3. American Conference of Governmental Industrial Hygienists, Documentation of the Threshold Limit Values (3d ed.), 1971, p. 700.

## § 1910.93u Cyclohexanone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of cyclohexanone, not in excess of 50 parts per million (ppm) of 200 milligrams per cubic meter (mg/cu m) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.93, Table G–1.

(2) "Action level" means one half (½) of the permissible exposure for cyclohexanone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which cyclohexanone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of cyclohexanone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of cyclohexanone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to cyclohexanone;

(ii) Any measurements of cyclohexanone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to cyclohexanone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to cyclohexanone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to cyclohexanone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

5) If an employee exposure measurement reveals that an employee is exposed to cyclohexanone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals an employee is exposed to cyclohexanone above the permissible exposure, the employer shall:

(i) Measure the exposure of the employee so exposed monthly;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to cyclohexanone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to cyclohexanone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurment.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B(IV) of this section for suggested measurement methods).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration: | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to cyclohexanone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of cyclohexanone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce ex-

posures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever feasible engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of cyclohexanone.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94(d), operations involving cyclohexanone shall be classified as B-4 at 70 degrees F.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of cyclohexanone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory protection for cyclohexanone*

| *Condition vapor concentration* | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge. |
| 2,500 p/m or less | Gas mask, chin style, front or back mounted organic vapor canister. |
| | Supplied air respirator with a full facepiece, hood, or helmet. |
| | Self - contained breathing apparatus with a full facepiece. |
| 5,000 p/m or less | Type C supplied air respirator with full facepiece operated in the pressure demand (positive presure) or with a full facepiece, hood, o helmet operated in continuous flow mode. |
| Greater than 5,000 p/m or entry and escape from unknown concentrations. | Any self-contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |
| | A combination respirator with a full facepiece which includes a type C supplied-air respirator operated in the pressure-demand (positive pressure) or continuous-flow mode and an auxiliary self - contained breathing apparatus operated in the pressure-demand (positive pressure) mode. |
| Firefighting | Any self-contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e) and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for cyclohexanone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of cyclohexanone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, cyclohexanone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of cyclohexanone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid cyclohexanone is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where cyclohexanone is present in the ductwork in concentrations greater than 2750 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(9) Sources of ignition such as smoking or open flames are prohibited where cyclohexanone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid cyclohexanone. Face shields shall comply with § 1910.133(a)(2), (4), (5), and (6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with cyclohexanone be removed promptly and not reworn until the cyclohexanone is removed from the clothing.

(3) Employers shall ensure that clothing wet with cyclohexanone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of cyclohexanone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyclohexanone, the employer shall inform the person performing the operation of the hazardous properties of cyclohexanone.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133 (a)(2)-(a)(6) where liquid cyclohexanone may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid cyclohexanone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid cyclohexanone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with cyclohexanone promptly wash or shower to remove any cyclohexanone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which cyclohexanone is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to cyclohexanone above the action level or employees who have skin contact with liquid cyclohexanone or employees who work where cyclohexanone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Cyclohexanone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to cyclohexanone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to

cyclohexanone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to cyclohexanone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid cyclohexanone or airborne concentrations of cyclohexanone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to cyclohexanone which are listed in Appendix A which the employee suspects are caused by exposure to cyclohexanone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for cyclohexanone;

(ii) A description of the affected employee's duties as they relate to his exposure to cyclohexanone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to cyclohexanone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to cyclohexanone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to cyclohexanone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid cyclohexanone or airborne concentrations of cyclohexanone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to cyclohexanone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to cyclohexanone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to cyclohexanone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to cyclohexanone;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to cyclohexanone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to cyclohexanone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply

with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne cyclohexanone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes to § 1910.93u is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR CYCLOHEXANONE

I. SUBSTANCE IDENTIFICATION.

A. SUBSTANCE: Cyclohexanone.

B. PERMISSIBLE EXPOSURE: 50 parts of cyclohexanone per million parts of air (ppm) or 200 milligrams of cyclohexanone per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. APPEARANCE AND ODOR: Colorless or slightly yellow liquid with a peppermint-like odor.

II. HEALTH HAZARD DATA.

A. Ways in Which the Chemical Affects Your Body: Cyclohexanone can affect your body if it is inhaled or if it comes in contact with your skin or eyes. It may also affect your body if you swallow it.

B. Effects of Exposure: 1. Short-Term Exposure: Cyclohexanone may cause irritation of the eyes, nose, and throat. It may also cause dizziness and unconsciousness.

2. Long-Term Exposure: Prolonged or repeated exposure of the skin to liquid cyclohexanone can cause a rash.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are associated with cyclohexanone exposure.

III. EMERGENCY FIRST AID PROCEDURES.

A. Eye Exposure: If cyclohexanone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If cyclohexanone gets on your skin promptly wash the contaminated skin using soap or mild detergent. If cyclohexanone soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of cyclohexanone move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When cyclohexanone has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of his throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Never try to make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the establishment emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING.

A. RESPIRATORS: Respirators are not the best way to control exposure to cyclohexanone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell cyclohexanone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid cyclohexanone.

C. EYE PROTECTION: You must wear splash-proof safety goggles where eye contact with liquid cyclohexanone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE.

Cyclohexanone is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever cyclohexanone is handled, used, or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of cyclohexanone, and containers must be bonded and grounded when pouring or transferring liquid cyclohexanone. If your skin becomes contaminated with cyclohexanone you must promptly wash or shower using soap or mild detergent to remove any cyclohexanone from your skin. You must promptly remove any nonimpervious clothing that becomes contaminated with liquid cyclohexanone and this clothing must not be reworn until the cyclohexanone has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know how to operate them. Ask your supervisor where cyclohexanone is used in your work area and for any additional safety rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS.

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request copies of these records be made available to your personal physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR CYCLOHEXANONE

I. PHYSICAL AND CHEMICAL DATA.

A. Substance Identification.

1. Synonyms: Pimelic ketone; cyclohexyl ketone

2. Formula: $C_6H_{10}O$

B. Physical Data.

1. Boiling point (760 mm Hg): 156.7 C (314 F)

2. Specific gravity (water=1): 0.95

3. Vapor density (air=1): 3.4

4. Melting point: −47 C (−52.6 F)

5. Vapor pressure at 20 C (68 F): 2 mm Hg

6. Solubility in water, % by weight at 20 C (68 F): 15

7. Evaporation rate (butyl acetate=1): 0.23

8. Appearance and odor: Clear to slightly yellow liquid. Peppermint-like odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA.

A. *Fire.* 1. Flash point: 43.9 C (111 F) (closed cup)

2. Autoignition temperature: 420 C (788 F)

3. Flammable limits in air, % by volume: Lower: 1.1 at 100 C (212 F)

4. Extinguishing media: Alcohol foam, dry chemical, or carbon dioxide.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to keep containers exposed to a fire cool.

6. Unusual fire and explosion hazards: Cyclohexanone is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when cyclohexanone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. Cyclohexanone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the cyclohexanone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, cyclohexanone is classified as a Class II combustible liquid. For example, 2750 ppm, one fourth of the lower flammable limit, is one situation in which cyclohexanone is considered to be a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for cyclohexanone shall be Class I, Group D.

B. *Reactivity.* 1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with oxidizing agents (especially nitric acid) may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving cyclohexanone.

4. Special Precautions: Cyclohexanone will attack and dissolve most plastics, resins, and rubbers.

III. SPILL, LEAK AND DISPOSAL PROCEDURES.

A. If cyclohexanone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber or absorbed on vermiculite, dry sand, earth or similar material and disposed in a sanitary land fill. Cyclohexanone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

C. Waste Disposal Methods:

Cyclohexanone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES.

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by calibrated instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses, or dosimeters. The method of measurement must determine the concentration of cyclohexanone to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described in paragraph (IV)(A). The method of measurement must determine the concentration of cyclohexanone to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS.

A. High exposures to cyclohexanone can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal cyclohexanone containers which must then be effectively grounded and bonded prior to pouring.

C. Store cyclohexanone in tightly closed containers in a cool well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to cyclohexanone could occur.

IV. COMMON OPERATIONS.

Some common operations in which exposure to cyclohexanone is likely to occur are use as a solvent for many inks, coatings, plastics, pesticides and explosives (RDX), as a lubricating oil additive, and as an intermediate in a commercial process for the manufacture of nylon 6, 6.

APPENDIX C

MEDICAL SURVEILLANCE GUIDLINES

I. ROUTE OF ENTRY.

Inhalation; insignificant skin absorption.

II. TOXICOLOGY.

There may be marked local irritation of the eyes and mucous membranes at relatively low levels of exposure to cyclohexanone, and central nervous system depression may occur on exposure to high concentrations, producing narcosis. Skin effects from the defatting action of liquid cyclohexanone could occur. No chronic efforts reported in humans.

III. SIGNS AND SYMPTOMS.

Irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS.

None in common usage.

V. TREATMENT.

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS.

A. *General.* Most reported effects of cyclohexanone are caused by its irritant properties. It is important that the physician become familiar with the operating conditions in which exposure to cyclohexanone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. *Preplacement.* Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease—Although cyclohexanone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment or renal function.

2. Chronic respiratory disease—In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of cyclohexanone might cause exacerbation of symptoms due to irritant properties or psychic reflex bronchospasm.

3. Liver disease—Although cyclohexanone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Skin disease—Cyclohexanone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of cyclohexanone.

C. *Periodic examinations.* Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

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ing Company, Amsterdam, 1965, pp. 443–445.

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3. Patty, F. A.: Industrial Hygiene and Toxicology, Volume II—Toxicology, Interscience Publishers, New York, 1962, pp. 1765–1768.

4. Grant, W. Morton: Toxicology of the Eye, Charles C. Thomas, Illinois, 1962, p. 159.

## § 1910.93v Hexone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of hexone, not in excess of 100 parts per million (ppm) or 410 milligrams per cubic meter (mg/cu m) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.93, Table G–1.

(2) "Action level" means one half (½) of the permissible exposure for hexone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which hexone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of hexone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of hexone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observation, or calculations which may indicate employee exposure to hexone;

(ii) Any measurements of hexone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to hexone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to hexone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to hexone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to hexone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals an employee is exposed to hexone above the permissible exposure, the employer shall:

(i) Measure the exposure of the employee so exposed monthly;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to hexone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to hexone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B(IV) of this section for suggested measurement methods).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration: | Required accuracy (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to hexone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of hexone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever feasible engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of hexone.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94 (d), operations involving hexone shall be classified as B–2 at 70 degrees F.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of hexone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select pdanor ffL
shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—RESPIRATORY PROTECTION FOR HEXONE

| Condition vapor concentration: | *Respiratory Protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge. |
| 3,000 p/m or less | A gas mask with a chin-style organic vapor canister. |
| | A gas mask with a front or back-mounted organic vapor canister. |
| | Any supplied-air respirator with a full facepiece, helmet, or hood. |
| | Any self-contained breathing apparatus with a full facepiece. |
| Greater than 3,000 p/m or entry and escape from unknown concentration | Self - contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |
| | A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in the pressure - demand (positive pressure) or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure - demand (positive pressure) mode. |
| Firefighting | Self - contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |

(6) Resporators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e) and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for hexone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of hexone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, hexone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of hexone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid hexone is classified as a Class 1C flammable liquid.

(6) Spray finishing operations shall be performed in accordance with §§1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where hexone is present in the ductwork in concentrations greater than 3500 ppm (25 percent of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(9) Sources of ignition such as smoking or open flames are prohibited where hexone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid hexone. Face shields shall comply with § 1910.133(a) (2), (4), (5), and (6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with hexone be removed promptly and not reworn until the hexone is removed from the clothing.

(3) Employers shall ensure that clothing wet with hexone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of hexone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the hexone, the employer shall inform the person performing the operation of the hazardous properties of hexone.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with § 1910.133(a)(2)–(a)(6) where liquid hexone may contact the eyes.

(5) Employers shall ensure that clothing which becomes wet with liquid hexone be removed immediately and not reworn until the hexone is removed from the clothing.

(g) *Spills and disposal.* (1) In the event that liquid hexone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid hexone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with hexone promptly wash or shower to remove any hexone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which hexone is present shall keep a copy of this regulation with Appendixes

A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to hexone above the action level or employees who have skin contact with liquid hexone or employees who work where hexone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Hexone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to hexone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to hexone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to hexone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid hexone or airborne concentrations of hexone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) the employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to hexone which are listed in Appendix A which the employee suspects are caused by exposure to hexone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for hexone;

(ii) A description of the affected employee's duties as they relate to his exposure to hexone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to hexone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to hexone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to hexone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid hexone or airborne concentrations of hexone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to hexone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.* (1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to hexone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to hexone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment.

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to hexone;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section

shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to hexone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to hexone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne hexone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes to § 1910.93v is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR HEXONE

I. SUBSTANCE IDENTIFICATION.

A. SUBSTANCE: Hexone.

B. PERMISSIBLE EXPOSURE: 100 parts of hexone per million parts of air (ppm) or 410 milligrams of hexone per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. APPEARANCE AND ODOR: Colorless liquid with a mint-like odor.

II. HEALTH HAZARD DATA.

A. Ways in Which the Chemical Affects Your Body: Hexone can affect your body if you inhale it, swallow it, or if it comes in contact with your skin or eyes.

B. Effects of Exposure: 1. Short-Term Exposure: Hexone may cause irritation of the eyes, nose, throat, and respiratory tract. Exposure to high concentrations may cause nausea, headaches, dizziness or unconsciousness.

2. Long-Term Exposure: Prolonged or repeated skin contact to liquid hexone may cause dryness and irritation of your skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are associated with hexone exposure.

III. EMERGENCY FIRST AID PROCEDURES.

A. Eye Exposure: If hexone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If hexone gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If hexone soaks through your clothing, remove the clothing and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing. If you or any other person breathes in large amounts of hexone, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When hexone has been swallowed, do not cause vomiting. Get medical attention immediately.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING.

A. RESPIRATORS: Respirators are not the best way to control exposure to hexone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell hexone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid hexone.

C. EYE PROTECTION: You must wear splash-proof safety goggles where eye contact with liquid hexone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE.

Hexone is a flammable liquid and its vapors can easily form explosive mixtures in air. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever hexone is handled, used, or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of hexone, and containers must be bonded and grounded when pouring or transferring liquid hexone. If your skin becomes contaminated with hexone, you must promptly wash or shower using soap or mild detergent to remove any hexone from your skin. You must immediately remove any clothing that becomes wet with liquid hexone and this clothing must not be reworn until the hexone has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where hexone is used in your work area and for any additional safety and health rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS.

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request copies of these records be made available to your personal physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR HEXONE

I. PHYSICAL AND CHEMICAL DATA.

A. Substance Identification.

1. Synonyms: 4-methyl-2-pentanone; methyl isobutyl ketone; isobutyl methyl ketone; MIBK.

2. Formula: $CH_3COCH_2C_3H_7$.

B. *Physical Data.* 1. Boiling point (76mm Hg): 116 C (241 F).

2. Specific gravity (water=1): 0.8.

3. Vapor density (air=1): 3.5.

4. Melting point: −84 C (−119 F).

5. Vapor pressure at 20 C (68 F): 15mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 1.9.

7. Evaporation rate (butyl acetate=): 1.64.

8. Appearance and odor: Colorless liquid with a mint-like odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA.

A. *Fire.* 1. Flash point: 22.8 C (73 F) (closed cup).

2. Autoignition temperature: 460 C (860 F).

3. Flammable limits in air, percent by volume: Lower: 1.4; Upper: 7.5.

4. Extinguishing media: Dry chemical, carbon dioxide or alcohol foam.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Hexone is a flammable liquid. Its vapors can form explosive mixtures in air. All ignition sources must be controlled when hexone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. Hexone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the hexone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, hexone is classified as a Class IC flammable liquid. For example, 3500 ppm, one fourth of the lower flammable limit, is one situation in which hexone is considered to be a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for hexone shall be Class I, Group D.

B. *Reactivity.* 1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving hexone.

4. Special Precautions: Dissolves some resins and rubbers.

III. SPILL, LEAK AND DISPOSAL PROCEDURES.

A. If hexone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities, can be collected and atomized in a suitable combustion chamber, or absorbed on vermiculite, dry sand, earth, or similar material and disposed of in a sanitary landfill. Hexone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.

C. Waste Disposal Methods:

Hexone may be disposed of:

1. By atomizing in a suitable combustion chamber.

2. By absorbing it in vermiculite, dry sand, earth, or similar material and disposing in a sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES.

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by calibrated instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses, dosimeters. The method of measurement must determine the concentration of hexone to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph (IV)(A). The method of measurement must determine the concentration of hexone to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS.

A. High exposures to hexone can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal hexone containers which must then be effectively grounded and bonded prior to pouring.

C. Store hexone in tightly closed containers in a cool, well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to hexone could occur.

VI. COMMON OPERATIONS.

Some common operations in which exposure to hexone is likely to occur are when it is used as a solvent in the manufacture or application of inks, lacquers and varnishes.

APPENDIX C

MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY.

Inhalation; insignificant skin absorption.

II. TOXICOLOGY.

There is local irritation of mucous membranes. Skin irritation may occur because of the solvent effect of hexone on the lipids. Central nervous system depression may occur on exposure to high concentrations. No chronic systemic effects reported.

III. SIGNS AND SYMPTOMS.

Intense irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS.

None in common usage.

V. TREATMENT.

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS.

A. *General.* Most reported effects of hexone are caused by its irritant properties. It is important that the physician become familiar with the operating conditions in which exposure to hexone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. *Preplacement.* Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease—Although hexone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease—In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of hexone might cause exacerbation of symptoms due to irritant properties or psychic reflex bronchospasm.

3. Liver disease—Athough hexone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Skin disease—Hexone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of hexone.

C. *Periodic examinations.* Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

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3. Patty, F. A.: Industrial Hygiene and Toxicology, Volume II—Toxicology, Interscience Publishers, New York, 1962, pp. 1731–1733.

4. Grant, W. Morton: Toxicology of the Eye, Charles C. Thomas, Illinois, 1974, pp. 358–359.

## § 1910.93w Methyl (n-amyl) ketone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of methyl (n-amyl) ketone, not in excess of 100 parts per million (ppm) or 465 milligrams per cubic meter (mg/cu m) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.93, Table G–1.

(2) "Action level" means one half (½) of the permissible exposure for methyl (n-amyl) ketone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which methyl (n-amyl) ketone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of methyl (n-amyl) ketone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of methyl (n-amyl) ketone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observation, or calculations which may indicate employee exposure to methyl (n-amyl) ketone;

(ii) Any measurements of methyl (n-amyl) ketone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to methyl (n-amyl) ketone; and

(iv) Date of determination, work being performed at the time, location within the worksite, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to methyl (n-amyl) ketone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to methyl (n-amyl) ketone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to methyl (n-amyl) ketone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals an employee is exposed to methyl (n-amyl) ketone above the permissible exposure, the employer shall:

(i) Measure the exposure of the employee so exposed monthly;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to methyl (n-amyl) ketone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to methyl (n-amyl) ketone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Method of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B (IV) of this section for suggested measurement methods).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

TABLE 1

| Concentration: | *Required accuracy* (percent) |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level. | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to methyl (n-amyl) ketone above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of methyl (n-amyl) ketone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever feasible engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of methyl (n-amyl) ketone.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94 (d), operations involving methyl (n-amyl) ketone shall be classified as B–3 at 70 degrees F.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of methyl (n-amyl) ketone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory protection for Methyl (n-amyl) ketone*

| Condition vapor concentration: | *Respiratory protection* *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Any chemical cartridge respirator with organic vapor cartridge.<br>Any supplied-air respirator.<br>Any self-contained breathing apparatus. |
| 4,000 p/m or less | A gas mask with a chin-style or front- or back-mounted organic vapor canister.<br>Any supplied-air respirator with a full facepiece, helmet, or hood.<br>Any self-contained breathing apparatus with a full facepiece. |
| Greater than 4,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.<br>A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in pressure-demand (positive pressure) or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in the pressure-demand (positive presure) mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part II.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e) and (f).

(e) *Fire and safety.* (1) the employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for methyl (n-amyl) ketone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of methyl (n-amyl) ketone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, methyl (n-amyl) ketone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of methyl (n-amyl) ketone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid methyl (n-amyl) ketone is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where methyl (n-amyl) ketone is present in the ductwork in concentrations greater than 2775 ppm (25% of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(9) Sources of ignition such as smoking or open flames are prohibited where methyl (n-amyl) ketone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid methyl (n-amyl) ketone. Face shields shall comply with § 1910.133(a) (2), (4), (5), and (6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with methyl (n-amyl) ketone be removed promptly, and not reworn until the methyl (n-amyl) ketone is removed from the clothing.

(3) Employers shall ensure that clothing wet with methyl (n-amyl) ketone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of methyl (n-amyl) ketone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the methyl (n-amyl) ketone, the employer shall inform the person performing the operation of the hazardous properties of methyl (n-amyl) ketone.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with §§ 1910.133 (a) (2)–(a) (6) where liquid methyl (n-amyl) ketone may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid methyl (n-amyl) ketone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid methyl (n-amyl) ketone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with methyl (n-amyl) ketone promptly wash or shower to remove any methyl (n-amyl) ketone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which methyl (n-amyl) ketone is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to methyl (n-amyl) ketone above the action level or employees who have skin contact with liquid methyl (n-amyl) ketone or employees who work where methyl (n-amyl) ketone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Methyl (n-amyl) Ketone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to methyl (n-amyl) ketone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to methyl (n-amyl) ketone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to methyl (n-amyl) ketone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid methyl (n-amyl) ketone or airborne concentrations of methyl (n-amyl) ketone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section, or any of the signs or symptoms of exposure to methyl (n-amyl) ketone which are listed in Appendix A which the employee suspects are caused by exposure to methyl (n-amyl) ketone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for methyl (n-amyl) ketone;

(ii) A description of the affected employee's duties as they relate to his exposure to methyl (n-amyl) ketone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to methyl (n-amyl) ketone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to methyl (n-amyl ketone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to methyl (n-amyl) ketone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid methyl (n-amyl) ketone or airborne concentrations of methyl (n-amyl) ketone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to methyl (n-amyl) ketone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.*—(1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to methyl (n-amyl) ketone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to methyl (n-amyl) ketone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to methyl (n-amyl) ketone;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to methyl (n-amyl) ketone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to methyl (n-amyl) ketone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne methyl (n-amyl) ketone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes to § 1910.93w is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR METHYL (N-AMYL) KETONE

I. SUBSTANCE IDENTIFICATION

A. SUBSTANCE: Methyl (n-amyl) ketone.

B. PERMISSIBLE EXPOSURE: 100 parts of methyl (n-amyl) ketone per million parts of air (ppm) or 465 milligrams of methyl (n-amyl) ketone per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. APPEARANCE AND ODOR: Clear colorless liquid with a mild "banana oil-like" odor.

II. HEALTH HAZARD DATA.

A. Ways in Which The Chemical Affects Your Body: Methyl (n-amyl) ketone can affect your body if you inhale it, swallow it, or if it comes into contact with your eyes and skin.

B. Effects of Exposure:

1. Short-Term Exposure: Methyl (n-amyl) ketone may irritate your eyes, nose, throat and may cause headaches, dizziness, and in extreme cases, unconsciousness.

2. Long-Term Exposure: Prolonged or repeated skin contact may cause dryness and irritation of your skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are associated with methyl (n-amyl) ketone exposure.

III. EMERGENCY FIRST AID PROCEDURES.

A. Eye Exposure: If methyl (n-amyl) ketone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If methyl (n-amyl) ketone gets on your skin promptly wash the contaminated skin using soap or mild detergent. If methyl (n-amyl) ketone soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of methyl (n-amyl) ketone remove the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When methyl (n-amyl) ketone has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposure person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING.

A. RESPIRATORS: Respirators are not the best way to control exposure to methyl (n-amyl) ketone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell methyl (n-amyl) ketone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield, and other protective clothing to prevent repeated or prolonged skin contact with liquid methyl (n-amyl) ketone.

C. EYE PROTECTION: You must wear splash-proof safety goggles where eye contact with liquid methyl (n-amyl) ketone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE.

Methyl (n-amyl) ketone is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong acids, alkalies, and oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever methyl (n-amyl) ketone is handled, used, or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of methyl (n-amyl) ketone, and containers must be bonded and grounded when pouring or transferring liquid methyl (n-amyl) ketone. If your skin becomes contaminated with methyl (n-amyl) ketone, you must promptly wash or shower using soap or mild detergent to remove any methyl (n-amyl) ketone from your skin. You must promptly remove any non-impervious clothing that becomes contaminated with liquid methyl (n-amyl) ketone and this clothing must not be reworn until the methyl (n-amyl) ketone has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know how to operate them. Ask your supervisor where methyl (n-amyl) ketone is used in your work area and for any additional plant safety rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS.

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request copies of these records be made available to your personal physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR METHYL (N-AMYL) KETONE

I. PHYSICAL AND CHEMICAL DATA.

A. Substance Identification.

1. Synonyms: N-amyl methyl ketone; 2-heptanone.

2. Formula: $CH_3COC_5H_{11}$.

B. Physical Data.

1. Boiling point (760 mm Hg): 151 C (304 F).

2. Specific gravity (water=1): 0.82.

3. Vapor density (air=1): 3.93.

4. Melting point: −35 C (−31 F).

5. Vapor pressure at 20 C (68 F): 2 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 0.43.

7. Evaporation rate (butyl acetate=1): 0.4.

8. Appearance and odor: Clear colorless liquid with a mild "banana oil-like" odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire.

1. Flash point: 49 C (120 F) (open cup).

2. Autoignition temperature: 532 C (991 F).

3. Flammable limits in air, % by volume: Lower: 1.11; Upper: 7.9.

4. Extinguishing media: Dry chemical, carbon dioxide, or foam.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Methyl (n-amyl) ketone is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when methyl (n-amyl) ketone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. Methyl (n-amyl) ketone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the methyl (n-amyl) ketone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, methyl (n-amyl) ketone is classified as a Class II combustible liquid. For example, 2775 ppm, one fourth of the lower flammable limit, is one situation in which methyl (n-amyl)

ketone is considered to be a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for methyl (n-amyl) ketone shall be Class I, Group D.

B. *Reactivity.* 1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong acids, alkalies, and oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving methyl (n-amyl) ketone.

4. Special precautions: Methyl (n-amyl) ketone will attack some forms of plastics, rubber, and coatings.

III. SPILL OR LEAK PROCEDURES.

A. If methyl (n-amyl) ketone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels, remove to a safe place (such as a fume hood) and burn the paper. Large quantities may be collected and atomized in a suitable combustion chamber, or absorbed on vermiculite, dry sand, earth or similar material and disposed of in a sanitary landfill. Methyl (n-amyl) ketone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.

C. Waste Disposal Methods: Methyl (n-amyl) ketone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or similar material and disposing in a sanitary landfill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES.

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by calibrated instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses, or dosimeters. The method of measurement must determine the concentration of methyl (n-amyl) ketone to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph (IV)(A). The method of measurement must determine the concentration of methyl (n-amyl) ketone to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS.

A. High exposures to methyl (n-amyl) ketone can occur when transferring the liquid from one container to another.

B. Non-sparking tools should be used to open and close metal methyl (n-amyl) ketone containers which must then be effectively grounded and bonded prior to pouring.

C. Store methyl (n-amyl) ketone in tightly closed containers in a cool, well-ventilated area away from ignition sources and strong oxidizing agents, alkalies and acids.

D. Employers must advise employees of all areas and operations where exposure to methyl (n-amyl) ketone could occur.

VI. COMMON OPERATIONS.

Some of the operations in which exposure to methyl (n-amyl) ketone may occur are spray application of lacquers, preparation of synthetic resins for metal roll coating and in working with solvents for rubber and nitrocellulose.

APPENDIX C

MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY.

Inhalation; insignificant skin absorption.

II. TOXICOLOGY.

There is some local irritation of the skin and respiratory tract by solvent effects of methyl (n-amyl) ketone on lipids. Central nervous system depression may occur on exposure to high concentrations, producing narcosis. Effects may be more pronounced in unacclimated individuals. No chronic systemic effects reported.

III. SIGNS AND SYMPTOMS.

Intense, irritation of eyes and mucous membranes of the upper respiratory tract; headache; narcosis, leading to coma may occur at sustained high levels. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS.

None in common usage.

V. TREATMENT.

None specific. Remove from exposure, give artificial resuscitation if indicated and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS.

A. General. Most reported effects of methyl (n-amyl) ketone are caused by its irritant properties. It is important that the physician becomes familiar with the operating conditions in which exposure to methyl (n-amyl) ketone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. *Preplacement.* Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease—Although methyl (n-amyl) ketone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease—In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of methyl (n-amyl) ketone might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

3. Liver disease—Although methyl (n-amyl) ketone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Skin disease—Methyl (n-amyl) ketone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of methyl (n-amyl) ketone.

C. *Periodic Examinations.* Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

REFERENCES

1. Patty, Frank A.: Industrial Hygiene and Toxicology, Volume II—Toxicology, Interscience Publishers, New York, 1962, page 1740.

2. Thienes, Clinton, and Thomas J. Haley: Clinical Toxicology, (Fifth edition), Lea & Febiger, Philadelphia, 1972, page 137.

## § 1910.93x Ethyl Butyl ketone.

(a) *Definitions.* (1) "Permissible exposure" means exposure of employees to airborne concentrations of ethyl butyl ketone, not in excess of 50 parts per million (ppm) or 230 milligrams per cubic meter (mg/cu m) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.93, Table G–1.

(2) "Action level" means one half (½) of the permissible exposure for ethyl butyl ketone.

(b) *Exposure determination and measurement.* (1) Each employer who has a place of employment in which ethyl butyl ketone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of ethyl butyl ketone at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of ethyl butyl ketone.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observation, or calculations which may indicate employee exposure to ethyl butyl ketone;

(ii) Any measurements of ethyl butyl ketone taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethyl butyl ketone; and

(iv) Date of determination, work being performed at the time, location within the work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to ethyl butyl ketone at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to ethyl butyl ketone at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to ethyl butyl ketone at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals an employee is exposed to ethyl butyl ketone above the permissible exposure, the employer shall:

(i) Measure the exposure of the employee so exposed monthly;

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to ethyl butyl ketone above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to ethyl butyl ketone below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph employee exposure is that which would occur if the employee were not using a respirator.

(c) *Methods of measurement.* (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (see Appendix B(IV) of this section for suggested measurement methods).

(2) The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1.

TABLE 1

| Concentration: | *Required accuracy (percent)* |
|---|---|
| Above permissible exposure | ±25 |
| At or below the permissible exposure and above the action level | ±35 |
| At or below the action level | ±50 |

(d) *Compliance.* (1) No employee shall be exposed to ethyl butyl ketone above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of ethyl butyl ketone shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever feasible engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of ethyl butyl ketone.

(ii) In the design of open-surface tank ventilation for the purposes of § 1910.94(d), operations involving ethyl butyl ketone shall be classified as B–3 at 70 degrees F.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of ethyl butyl ketone to at or below the permissible exposure; or

(iv) For operations which require respirator use for not longer than one hour per day and not more frequently than one day per week; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2.—*Respiratory Protection for Ethyl Butyl Ketone*

| Condition vapor concentration: | *Respiratory protection* |
|---|---|
| 1,000 p/m or less | Chemical cartridge respirator with full facepiece and organic vapor cartridge. |
| | A gas mask with chin-style organic vapor canister. |
| | A gas mask with a front or back-mounted organic vapor canister. |
| | Any supplied-air respirator with a full facepiece, helmet, or hood. |
| | Any self-contained breathing apparatus with a full facepiece. |
| 3,000 p/m or less | A type C supplied-air respirator with full facepiece operated in the pressure-demand (positive pressure) mode or with a full facepiece, helmet, or hood operated in the continuous-flow mode. |
| Greater than 3,000 p/m or entry and escape from unknown concentrations. | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |
| | A combination respirator which includes a type C supplied-air respirator with a full facepiece operated in the pressure-demand (positive pressure) or continuous flow mode and an auxiliary self-contained breathting apparatus operated in the pressure-demand (positive pressure mode. |
| Firefighting | Self-contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. |

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e) and (f).

(e) *Fire and safety.* (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for ethyl butyl ketone.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of ethyl butyl ketone shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, ethyl butyl ketone is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of ethyl butyl ketone shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid ethyl butyl ketone is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where ethyl butyl ketone is present in the ductwork in concentrations greater than 3500 ppm (25% of the lower

flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(9) Sources of ignition such as smoking or open flames are prohibited where ethyl butyl ketone presents a fire or explosion hazard.

(f) *Personal protective equipment.* (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid ethyl butyl ketone. Face shields shall comply with § 1910.133(a) (2), (4), (5), and (6).

(2) Employers shall ensure that nonimpervious clothing which becomes contaminated with ethyl butyl ketone be removed promptly and not reworn until the ethyl butyl ketone is removed from the clothing.

(3) Employers shall ensure that clothing wet with ethyl butyl ketone is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of ethyl butyl ketone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethyl butyl ketone, the employer shall inform the person performing the operation of the hazardous properties of ethyl butyl ketone.

(4) Employers shall provide and ensure that employees use cup-cover type dust and splash safety goggles which comply with §1910.133(a) (2)—(6) where liquid ethyl butyl ketone may contact the eyes.

(g) *Spills and disposal.* (1) In the event that liquid ethyl butyl ketone is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill.

(2) Liquid ethyl butyl ketone shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) *Sanitation.* Employers shall ensure that employees whose skin becomes contaminated with ethyl butyl ketone promptly wash or shower to remove any ethyl butyl ketone from the skin.

(i) *Training and information.* (1) Each employer who has a workplace in which ethyl butyl ketone is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to ethyl butyl ketone above the action level or employees who have skin contact with liquid ethyl butyl ketone or employees who work where ethyl butyl ketone presents a fire or explosion hazard shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for Ethyl Butyl Ketone (Appendix A of this section);

(ii) Advise affected employees of the signs and symptoms of exposure to ethyl butyl ketone;

(iii) Instruct affected employees to advise the employer of the development of signs or symptoms of exposure to ethyl butyl ketone which are listed in Appendix A of this section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j) (2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ethyl butyl ketone.

(j) *Medical surveillance.* (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid ethyl butyl ketone or airborne concentrations of ethyl butyl ketone at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease;

(ii) Liver disease;

(iii) Chronic respiratory disease;

(iv) Skin disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j) (2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j) (2) of this section, or any of the signs or symptoms of exposure to ethyl butyl ketone which are listed in Appendix A which the employee suspects are caused by exposure to ethyl butyl ketone.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for ethyl butyl ketone;

(ii) A description of the affected employee's duties as they relate to his exposure to ethyl butyl ketone;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j) (3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j) (6) of this section.

(6) (i) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to ethyl butyl ketone or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to ethyl butyl ketone, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to ethyl butyl ketone.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid ethyl butyl ketone or airborne concentrations of ethyl butyl ketone in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to ethyl butyl ketone.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) *Recordkeeping.* (1) *Exposure determination.* (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b) (1) of this section.

(ii) The record shall include the written determination required in paragraph (b) (2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) *Exposure measurements.* (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to ethyl butyl ketone.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to ethyl butyl ketone which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results, and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number, and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) *Mechanical ventilation.* (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d) (3) (i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken; and

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) *Employee training and information.* (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained; and

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) *Medical surveillance.* (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j) (2) of this section;

(B) Any employee medical complaints relative to exposure to ethyl butyl ketone;

(C) A copy of information provided to the physician pursuant to paragraph (j) (4) (ii), (iii), (iv), (v), and (vi) of this section;

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) *Access to records.* (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) *Employee observation of measurement.* (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to ethyl butyl ketone which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to ethyl butyl ketone requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement observers shall be entitled to:

(i) Receive an explanation of the measurement procedure;

(ii) Visually observe all steps related to the measurement of airborne ethyl butyl ketone that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes to § 1910.93x is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR ETHYL BUTYL KETONE

I. SUBSTANCE IDENTIFICATION

A. SUBSTANCE: Ethyl butyl ketone.

B. PERMISSIBLE EXPOSURE: 50 parts of ethyl butyl ketone per million parts of air (ppm) or 230 milligrams of ethyl butyl ketone per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. APPEARANCE AND ODOR: Ethyl butyl ketone is a colorless liquid with a mild fruity order.

II. HEALTH HAZARD DATA.

A. Ways in Which the Chemical Affects Your Body: Ethyl butyl ketone can affect your body if you inhale it, swallow it, or if it comes in contact with your skin or eyes.

B. Effects of Exposure:

1. Short-term Exposure: Ethyl butyl ketone may cause irritation of the eyes, nose, and throat. Exposure to high concentrations may cause headaches, dizziness or unconsciousness.

2. Long-Term Exposure: Prolonged or repeated skin contact may cause dryness and irritation of your skin.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are associated with ethyl butyl ketone exposure.

III. EMERGENCY FIRST AID PROCEDURES.

A. Eye Exposure: If liquid ethyl butyl ketone gets into your eyes, wash the eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If ethyl butyl ketone gets on your skin, promptly wash the contaminated skin using soap or mild detergent If ethyl butyl ketone soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. If irritation persists, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of ethyl butyl ketone move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

D. Swallowing: When ethyl butyl ketone has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.

E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING.

A. RESPIRATORS: Respirators are not the best way to control exposure to ethyl butyl ketone. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell ethyl butyl ketone while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield, and other protective clothing to prevent repeated or prolonged skin contact with liquid ethyl butyl ketone.

C. EYE PROTECTION: You must wear splash-proof safety goggles where eye contact with liquid ethyl butyl ketone may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE.

Ethyl butyl ketone is a combustible liquid and its vapors can form explosive mixtures in air at elevated temperatures. It must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources and strong oxidizing agents. Sources of ignition such as smoking and open flames are prohibited wherever ethyl butyl ketone is handled, used, or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of ethyl butyl ketone, and containers must be bonded and grounded when pouring or transferring liquid ethyl butyl ketone. If your skin becomes contaminated with ethyl butyl ketone, you must promptly wash or shower using soap or mild detergent to remove any ethyl butyl ketone from your skin. You must promptly remove any non-impervious clothing that becomes contaminated with liquid ethyl butyl ketone and this clothing must not be reworn until the ethyl butyl ketone has been removed from the clothing. Fire extinguishers, where provided, must be readily available and you should know how to operate them. Ask your supervisor where ethyl butyl ketone is used in your work area and for any additional plant safety rules.

VI. EMPLOYEE MEDICAL AND EXPOSURE RECORDS.

Your employer is required to retain records of exposure measurement for one year or until replaced by a more recent record and medical records for the length of the employment. You may wish to request that copies of these records be made available to your personal physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR ETHYL BUTYL KETONE

I. PHYSICAL AND CHEMICAL DATA.

A. Substance Identification.

1. Synonyms: butyl ethyl ketone, 3-heptanone.

2. Formula: $C_2H_5COC_4H_9$.

B. *Physical Data.* 1. Boiling point (760 mm Hg): 147 C (297 F).

2. Specific gravity (water=1): 0.82.

3. Vapor density (air=1): 3.93.

4. Melting point: −38 C (−36.4 F).

5. Vapor pressure at 20 C (68 F): 4 mm Hg.

6. Solubility in water, % by weight at 20 C (68 F): 0.43.

7. Evaporation rate (butyl acetate=1): 0.45.

8. Appearance and odor: Colorless liquid with a mild fruity odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA.

A. *Fire.* 1. Flash point: 46 C (115 F) (open cup).

2. Autoignition temperature: Data not available.

3. Flammable limits in air, % by volume: Lower: 1.4, Upper: 8.8.

4. Extinguishing media: Carbon dioxide, dry chemical, or foam.

5. Special fire-fighting procedures: Do not use solid stream of water, since the stream will scatter and spread the fire. Use water spray to keep fire-exposed containers cool.

6. Unusual fire and explosion hazards: Ethyl butyl ketone is a combustible liquid. Its vapors can form explosive mixtures in air at elevated temperatures. All ignition sources must be controlled when ethyl butyl ketone is used, handled, and stored in a manner that could create a potential fire or explosion hazard. Ethyl butyl ketone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the ethyl butyl ketone is handled.

7. For the purpose of conforming to the requirements of 29 CFR 1910.106, ethyl butyl ketone is classified as a Class II combustible liquid. For example, 3500 ppm, one fourth the lower flammable limit, is one situation in which ethyl butyl ketone is considered to be a potential fire and explosion hazard.

8. For the purpose of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for ethyl butyl ketone shall be Class I, Group D.

B. *Reactivity.* 1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosion.

3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving ethyl butyl ketone.

4. Special Precautions: Ethyl butyl ketone will attack some forms of plastics, rubber, and coatings.

III. SPILL OR LEAK PROCEDURES.

A. If ethyl butyl ketone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels, remove to a safe place (such as a fume hood) and burn the paper. Large quantities may be collected and atomized in a suitable combustion chamber, or absorbed on vermiculite, dry sand, earth or similar material and disposed of in a sanitary landfill. Ethyl butyl ketone may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.

C. Waste Disposal Methods: Ethyl butyl ketone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or similar material and disposing in a sanitary landfill.

2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES.

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken in a fashion such that the average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by calibrated instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of ethyl butyl ketone to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph (IV) (A). The method of measurement must determine the concentration of ethyl butyl ketone to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS.

A. High exposures to ethyl butyl ketone can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal ethyl butyl ketone containers which must then be effectively grounded and bonded prior to pouring.

C. Store ethyl butyl ketone in tightly closed containers in a cool, well-ventilated area away from ignition sources and strong oxidizing agents.

D. Employers must advise employees of all areas and operations where exposure to ethyl butyl ketone could occur.

VI. COMMON OPERATIONS.

Exposure to ethyl butyl ketone may occur during application of lacquers and surface coatings, use of mastics and adhesives, and cleaning and maintenance of ketone process equipment.

APPENDIX C

MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY.

Inhalation; insignificant skin absorption.

II. TOXICOLOGY.

There is some local irritation of the skin and respiratory tract by solvent effect of ethyl butyl ketone on lipids. Central nervous depression occurs on exposure to high concentrations, producing narcosis. Effects may be more pronounced in unacclimated individuals. No chronic systemic effects reported.

III. SIGNS AND SYMPTOMS.

Intense irritation of eyes and mucous membranes of the upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels. Excessive skin contact may produce a dermatitis.

IV. SPECIAL TESTS.

None in common usage.

V. TREATMENT.

None specific. Remove from exposure. Give artificial resuscitation if indicated, and wash eyes and contaminated skin with water. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS.

A. *General.* Most reported effects of ethyl butyl ketone are caused by its irritant properties. It is important that the physician becomes familiar with the operating conditions in which exposure to ethyl butyl ketone occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. *Preplacement.* Routine medical histories and physical examinations are not required. However the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease—Although ethyl butyl ketone is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease—In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethyl butyl ketone might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

3. Liver disease—Although ethyl butyl ketone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Skin disease—Ethyl butyl ketone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of ethyl butyl ketone.

C. Periodic Examinations.

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

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(Secs. 6, 8, 84 Stat. 1593, 1599 (29 U.S.C. 655, 657); Secretary of Labor's Order No. 12–71, 36 FR 8754, and 29 CFR Part 1911)

Signed at Washington, D.C. this 29th day of April, 1975.

JOHN STENDER,
*Assistant Secretary of Labor.*

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